Removal and Recovery of Mercury from Mixed Wastes

Developer: Mercury Recovery Services
Contract Number: DE-AR21-94MC31189
Crosscutting Area: ESP

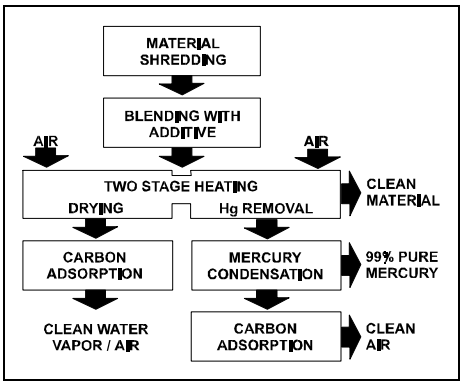
Mixed Waste FOCUS AREA

Problem:

Numerous Department of Energy (DOE) facilities are faced with mercury contamination problems including difficulties in disposing of mercury-contaminated radioactive soils and wastes. The EPA's Third Land Ban, which prohibits land disposal of any material containing greater than 260 ppm total mercury, precludes land disposal of mercury-contaminated radioactive wastes. A method of completely removing mercury from mixed waste without producing secondary radioactive wastes is required.

Solution:

A practical process for the separation of mixed mercury-bearing waste must have the ability to reduce the residual mercury content in the treated waste to the lowest practical level, recover the mercury in a form suitable for recycling, retain the radioactive constituents in the treated material, produce no secondary wastes, eliminate contaminants from the process exhaust, and have no adverse effects upon workers and the environment. This technology removes mercury from soils and wastes to a level less than 1 ppm and confines all radioactivity to the base material while recovering pure metallic mercury. The recovered mercury is suitable for reuse.



Benefits:

- Selectively removes mercury from mixed waste
- Reduces residual total mercury to < 1 ppm
- Recovers 99% pure metallic mercury
- Produces no secondary liquid, solid, or gaseous waste
- Recovers mercury from oxides, sulfides, chlorides, and other compounds and keeps sulfur- and chlorine-bearing gases out of the process exhaust
- Uses secondary containment to protect workers and the environment

Technology:

The technology development involves the use of a medium-temperature, low-gas-flow thermal desorption process. The process includes comminution of the material; blending with additives to decompose compounds; heating the material in a low-volume, low-velocity air stream in two stages - a low temperature stage during which water vapor is removed and a second stage at a temperature sufficient to vaporize mercury from the dry material; exhausting the generated water vapor to the atmosphere in gaseous form through a gas purification system which removes all traces of mercury; condensing the vaporized mercury to metallic form; and treating the gaseous effluent to remove mercury and other gaseous and/or particulate contaminants prior to discharge. The project was completed in four tasks.

Task 1 involved identifying and selecting a matrix material that was representative of a typical low-level radioactive DOE waste stream and preparing surrogate waste streams therefrom by characterizing the uncontaminated soil matrix and blending it into mixtures consisting of one or more of cerium, cerium oxide, mercury oxide, mercury

chloride, mercury sulfide, metallic mercury, and Naturally Occurring Radioactive Material (NORM). The NORM was added in an amount below 20 pCi/gram.

During Task 2, all of the samples were subjected to chemical and physical analyses, particle size determination, scanning electron microscopy, x-ray diffraction, and TCLP tests, in order to determine the physical and chemical nature of the matrix and its interaction with the contained additives.

Task 3 determined the optimum processing conditions (time, temperature, carrier gas flow, physical and chemical pretreatments, etc.), determined the resulting residual mercury content and TCLP values for each, and confirmed the chosen conditions on the NORM samples while monitoring all feeds, treated materials, recovered mercury, and the exhaust gases for radioactivity in the NORM tests.

Task 4 involved preparation of a preliminary design for a commercial processing facility capable of treating DOE wastes and a detailed projection of the capital and operating costs for commercial mobile and fixed site facilities having treatment capacities suitable for DOE remediation projects.

Project Conclusion:

The development of the soil treatment parameters required to remove and recover mercury from mixed low-level radioactive wastes and issuance of the final report was completed in June 1995. Mercury levels up to 3000 ppm in the waste stream were reduced to less than 1 ppm without disturbing the radioactive components in the waste stream, and without producing secondary wastes.

This technology offers a viable means of removing and recovering the mercury form low level mixed wastes, obtaining an effective separation of the mercury from the radioisotopes by the retention of the radioisotopes in the solid residuals, and economically processing low level mixed wastes of volumes generated at DOE facilities.

The technology is ready for scaleup to commercial treatment of mercury-contaminated mixed wastes. The capital investment required to construct a facility capable of processing 110 tons of waste per day was estimated to be approximately $10.5 million dollars. Operating costs for the same facility were estimated at $107 per ton of waste processed.

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Contacts:

Mercury Recovery Services performs research and development and provides commercial treatment services in the area of mercury removal and recovery from soils and industrial wastes. For information on this project, the contractor contact is:

Principal Investigator:
Mr. William F. Sutton
Mercury Recovery Services
700 5th Avenue
New Brighton, PA 15066
Phone: (412) 843-5000
Fax: (412) 843-5353
E-mail: None

DOE's Federal Energy Technology Center supports the Environmental Management - Office of Science and Technology by contracting the research and development of new technologies for waste site characterization and cleanup. For information regarding this project, the DOE contact is:

DOE Project Manager:
Mr. Clifford P. Carpenter
Federal Energy Technology Center
3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880
Phone: (304) 285-4041
Fax: (304) 285-4403
E-mail: ccarpe@fetc.doe.gov